Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 16 Issue 3 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Removal Anionic Dye from Aqueous Solutions using Biopolymere

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Abstract- Dyes have long been used in dyening, paper and pulp, texstile, plastics, leather paint, cosmetics and food industries. This poses certain hazards and environmental problems. the objective of this study is to investigate the adsorption behaviour of metyl orange from aqueous solution onto chitosan. The effect of initial dye concentration, contact time, initial pH, and adsorbent dosage were studied. the Langmuir and Fredlich adsorption models were applied to describe the equilibrium isotherm.

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GJSFR-H Classification : FOR Code: 969999p

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I. Introduction

Environmental pollution due to industrial effluents is of major concern because of their toxicity and threat for human life and the environment. the discharge of textile effluent with the entry of toxic components into the food chains of humans and animal. Synthetic dyes are extensivety used for dyeig and printing in a variety of industries [1]. the removal of colour from textile effluents has targeted attention over the last few years, not only because of its toxicity, but mainly due to its visibility. Conventional treatement facilities are often unable to remove certain forms of colour, particularly those arising from reactive dyes as a result of their high solubility and low biodegradability; thus, methods for decolourizing textile effluents are on the horizon [2]. Over 10.000 dyes with an annual production over 7x 10^5 metri tonnes worldwide are commercially available and 5-1% of the dye stuff is lost in the industrial effluent. therefore, there is a need to remove dyes before effluent is discharged into receiving water bodies.

The mehods of colour removal from industrial effluent include coagulation, flocculation, biological treatement, hyper filtration, adsorption and oxidation .Among these options adsorption is most preferred method and activated carbon is most effective adsorbents widely employed to treat wastewater containing different classes of dyes, recognizing the economical drawback of commercial activated carbon.

Special attention has been given to a natural amino polysaccharide called Chitosan. Chitosan is a partially acetylated glucosamine biopolymer, with mainly results from the deacetylation of chitin, which is a major component of arthropod and crustacean shells such as lobsters, shrimps, crabs and cuttlefishes [3]. As shown from figure 1, chitosan has three types of reactive functional groups, an amino group as well as both primary and secondary hydroxyl groups at the C-2, C-3andC-6positions, respectively .Its advantage over other polysaccharides is that its chemical structure allows specific modifications, especially at the C-2 position. These functional groups allow direct substitution reaction and chemical modifications, yielding numerous useful materials for different domains of application [4].

Chitosan is known as an ideal support material for enzyme immobilization because of its many advantages such as its hydrophilicity, biodegradability and anti- bacterial property [5]. Chitosan is widely used for the removal of heavy, transition metals and dyes because amine groupe ($-NH_2$) and hydroxyl group (-OH) on the polymer chain of chitosan can adsorb both cationic and anionic molecules [6].

II. Material and Methods

a) Adsorbent

Chitosan was purchased from the Sinopharm group Chemical Reagent Limited Company (china).The degree of deacetylation was 90% and the molecule weight was 100.000 g/mol.

b) Adsorbate

Methyl orange (MO) was supplied by Sigma chemical company, and used as adsorbate in the tests.

c) Equilibrium studies

Adsorption Experiment were carried by 0.5g of chitosan into 250ml Erlenmeyer flasks containing 200ml solution of different concentrations (5.10, 20,25mg/l) of MO. The temperature was controlled at 25°C. Agitation speed was kept constant 600 rpm for 120min. the effected pH, varied between 2,4 and 12 was studied by adjusting the pH of solution using dilute H_2SO_4 and NaOH solution. the dye concentration (50mg/l), the adsorption time120min, the striring speed 600(rpm) and at room temperature were used.

The solution and solid phase were separated by centrifugation at 150rpm for five minute .the dye adsorption capacity at equilibrium q_e can be calculated from the equation given below

$$q_e = v/m\ (C_0\text{-}C_e\text{-})$$

Where C_0(mg/l) is the initial dye concentration in liquid phase, C_e (mg/l) denotes the concentration in liquid phase at equilibrium, V(l) represents the total

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volume of the dye solution, and m(g) is the mass of the adsorbent.

III. Results and Discussion

a) Effect of contact time

Contact time in another important variable in adsorption process. figure 1 shows the effect the contact time on adsorption the MO. As ssen, the uptake rate of the dye was very high for the first 5 min, with increase in time until it approache the equilibrium loading capacity. Equilibrium was estabilished after 120 min smilar result was found for the adsorption kinetic of MO on chitosan [7].

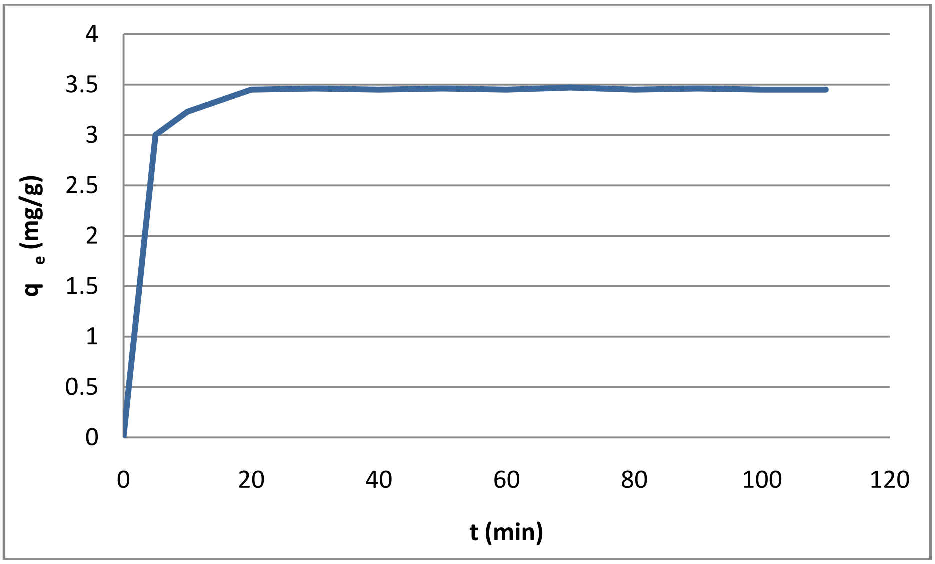

Figure1 : Effect of contact time on the adsorption process for MO (Temperature 25°C, adsorbent dose = 50mg/l, rotation per minute = 600rpm)

b) Effect of initial MO concentration

Figure2 shows the effect of contact time on adsorption for various MO concentration. As ssen, the uptake rate of the dye was very high for the first 5 min, with increase in time until it approache the equilibrium loading capacity. Equilibrium was estabilished after 120 min smilar result was found for the adsorption kinetic of acid dyes from aqueous solution by chitosan [7].

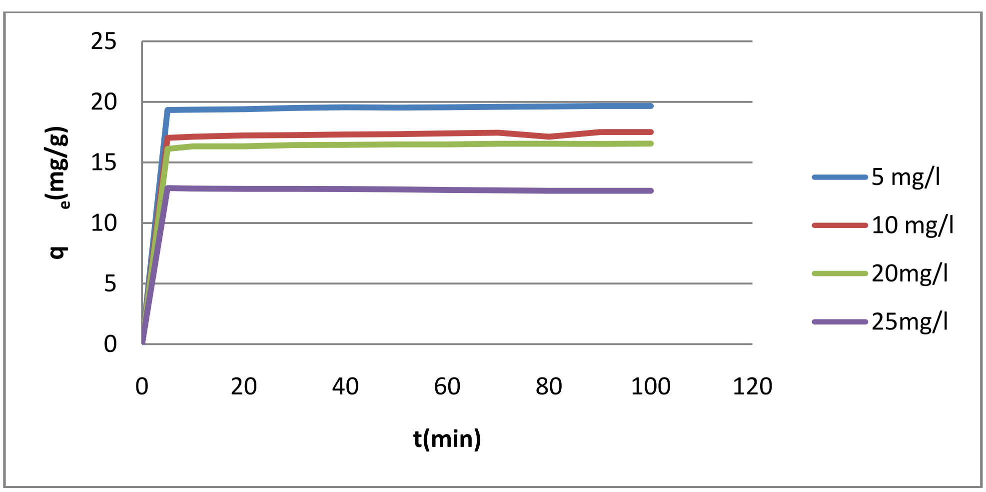

Figure 2 : Effect of MO concentration on the adsorption of MO on chitosan (Temperature = 25°C, agitation rate 600rpm)

c) Effect of pH on adsorption

pH is one of the important factors in controlling the adsorption process. To evaluate the effect of PH on the adsorption process, the adsorption of the dye with pHvalues from 2,4,12. It was observed after analyzing figure3 the amount of dye adsorbed per unit weight of adsorbent (q_e) increased with decreasing pH values. As the pH of the solution decrease, the surface charge density increase and the electrostatic repulsions between the adsorbent and the negatively charged cationic dye is high, thereby increasing the extent of adsorption.

Similar result was found for the adsorption kinetic of acid dyes from aqueous solution by chitosan [7].

However, this time the adsorption capacity is effected by the pH such that the amount of dye adsorbed increase in the order of pH 2›4›12 [8].

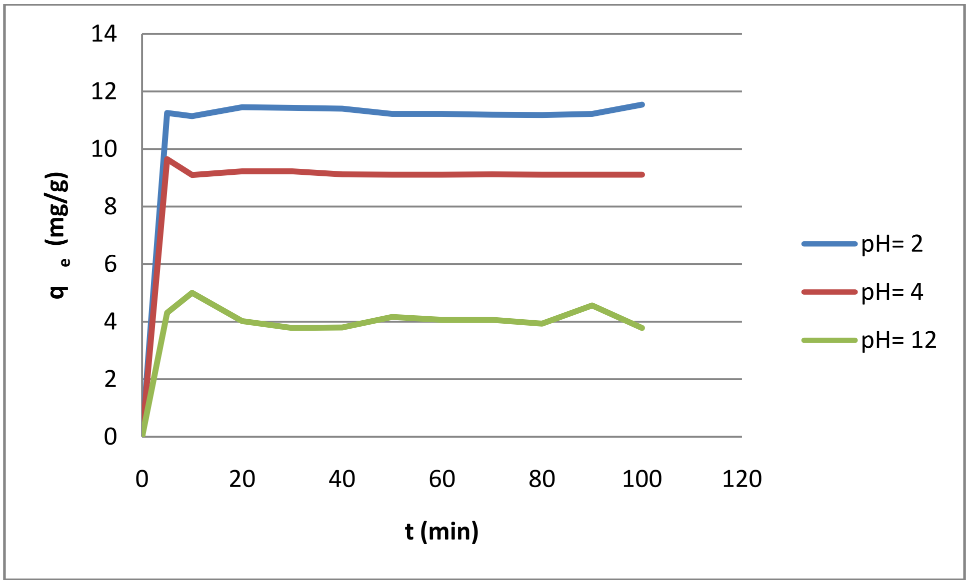

Figure 2 : Effect of PH on the amount of dye adsorbed per unit weight (q_e) for adsorption of MO on chitosan (Temperature = 25°C, agitation rate 600rpm, adsorbet dose = 50mg/l)

IV. Conclusion

The adsorption of MO onto chitosan was dependent on solution pH, contact time and initial concentration.

Conclusion from this study can be represented as follows:

It was also concluded that pH marked affected on the adsorption and increased with the decrease in pH.

It was found that initial concentration of dye has a significant effected on the adsorption of dye.

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